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The American Biology Teacher

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The American Biology Teacher

Vol. 13 APRIL, 1951 No. 4

The address by Ernest A. Neal, of which a digest appears below, was one of a symposium on *Human Resources for Learning Science*. This was presented at a joint session of ANSS, NSTA and NABT, with President Betty Lockwood of NABT presiding, December 28, 1950.

Developing a Science Program Around the Needs of the People

ERNEST E. NEAL

Director, Rural Life Council, Tuskegee Institute, Tuskegee, Alabama

It is encouraging to note that you, the teachers of science, are considering at this meeting the development of a science program around the needs of people. It would be presumptuous on my part to tell you what kind of science program you need to develop; but I can, however, discuss with you the needs of people.

Too frequently we forget that people still live in communities. It is from the community that people get their basic needs satisfied. The degree to which needs are satisfied and people's problems become less depends upon the type of community in which they live. I shall attempt to discuss with you how people's needs arise out of the community, and how the community can be used as an instrument to meet the needs of people.

Man's Cultural Evolution

Where technology is simple and crude, man's relations with other organisms are close and familiar, and man's needs are few and simple. All of his needs can be supplied by the biotic community of which he is a part. He can survive on the vegetation and the wild life of the area without being concerned with the cultivation of the plants or care for the animals.

Each acquisition of a new technique or a new use of an old technique alters man's relations with the organisms about him and changes his position in the biotic community.

"Human life, however, especially since the beginning of the nineteenth century and the recent tremendous strides in cultural advancement, requires more than organic material for maintenance. To an increasing extent, civilized people have come to use inorganic materials in meeting life's requirements. This is evi-

denced not merely in the increasing use of minerals in the manufacture of bigger and more elaborate tools, but also in the development of synthetic products which serve as substitutes for organic materials. . . . The development of artificial silk shifted man's dependence from the animal to the green plant level. A century ago, the primary means of illumination was animal fats; fats were later displaced by petroleum products; and today, electric energy, obtained from water power, is in common use as a means of artificial light. Animal power is everywhere giving way to mechanical power. But a counter trend should not be overlooked. Man is also beginning to turn away from certain inorganic materials as the easily accessible natural resources near exhaustion. . . .

"Nevertheless, man's growing use of inorganic materials has progressed far. One of the principal manifestations of this tendency is the extensive use of such materials in the construction of an environment peculiar to himself composed of concrete highways; buildings of glass, steel, concrete; etc. The supreme expression of this, of course, is the modern city wherein man has virtually isolated himself from the natural environment. Indeed, almost the only element of geography with which urban man is familiar is space—even climate is transmuted into weather in cities. Fraternization with living members of other species is for the city dweller largely a matter of keeping pets or suffering from disease. There is little question that the city is the fullest expression of human dominance." *

The Needs of People

Basically, the needs of people today are a result of a transition from an agrarian society to an urbanized society without the accompanying changes in community institutions to cope with the changes in our way of life.

The development of manufacturing exerts a two-way flow for the growth of cities. It provides jobs—thereby assembling a large number of workers and their families—and an accompanying group of service workers to serve the needs of the workers' families. Manufacturing also produces labor-saving devices, thereby displacing more people from agriculture and other extractive industries. It also provides transportation and communication equipment by which scattered populations are interrelated.

The products of manufacturing are the instruments that provided the means of transition from a nation of isolated villages and small towns to an urbanized society.

Just as the automobile was the instrument that expanded the area of urban communities and linked the city with the outlying areas, the tractor was the instrument that changed the pattern of farm life. The tractor and its accompanying equipment displaced farm laborers, increased the size of farm units, broke down community lines, and released people to move on to the city. The tractor—assisted by the truck, bus, and hard-surfaced road—is eliminating the crossroads stores, one-room schools, villages, churches, and local processing and storage facilities.

The Problem of Transition

Those of you who are not from the South were favored with a gradual transition from hand labor to machine labor on the farm, and from a predominantly rural to a predominantly urban society. Therefore, you have not witnessed upheavals in your economy as is in evidence in the South.

Within the past twenty years, a technological revolution has taken place in

* Hawley, Amos H. *Human Ecology*. New York: Ronald Press, 1950. p. 63.

the South. The tractor, the mechanical cotton picker, and the development of industries are completely reorganizing the region. In such a period of transition, a number of problems arise. Tractors supplant mules and plowhands; mechanical choppers and pickers supplant hands for hoeing and picking cotton. People made useless by these changes are pushed off the farm. They move on to the nearby small towns, then to the large cities in the South, and finally to the industrial centers out of the South.

As a result of these changes, we are sending you people; people you did not ask for; people lacking in skills and thought-ways that fit them for productive work in your cities.

I have called your attention to what is happening in the South because it is in the South where the needs of the people are the most pronounced. It is in the South that we see more vividly what changes in technology mean to people.

The Development of Resource-Use Education

Because our problems are so acute in the South, we have been more concerned than any other region in the United States in utilizing our educational institutions to help with the solution of our problems.

"In April, 1943, a group of southern educators and research specialists accepted the task of exploring the possibilities for development of a region-wide program to make research findings available for educational use. At that time, the American Council on Education appointed the Committee on Southern Regional Studies and Education to conduct a seven month's exploratory study. The Committee was charged with responsibility to:

1. Define the needs of the southern area with particular reference to a possible educational program. This involves the discovery of the most pressing human problems and the cataloguing of the resources to meet them.
2. Find out what research materials bearing on those needs and resources are available and what gaps exist. This proposed program is not designed to fill the gaps, but it might be helpful in getting them filled by other agencies.
3. Discover and evaluate what is going on in the production and use of instructional materials related to the needs and resources of the South.
4. Consider how new teaching materials may be prepared through the cooperation of regional organizations, state departments of education, universities and colleges, and school systems.
5. Consider ways and means of getting new materials and those already available into use in the educational process. This would imply the use of schools, colleges, libraries, and other community and state educational agencies.
6. Prepare a report which would serve as a guide to an action program throughout the southern states, and for other regions, states, and communities.*

Since the organization of the Committee on Southern Regional Studies and Education to promote the development of a resource-use education program, results have been phenomenal. Universities, colleges, high schools, and elementary schools have joined in a program of resource-use education designed at meeting the needs of the people. The projects underway run all the way from use of native shrubbery to beautify a school lawn to the use of isotopes from atomic energy for plant food.

The secret of the success of the resource-use education program in the

* Ivey, John E., Jr. *Channeling Research into Education.* (Series I: Reports of Committees and Conferences, No. 19, Vol. VIII.) Washington: American Council on Education Studies (August, 1944), pp. xii–xiii.

South is due primarily to the fact that the program focuses its attention on the needs of the people.

The fast growing livestock industry had to wait until the scientists were able to develop year-round grazing and effective preventatives against cattle diseases. When southern farmers were confronted with thousands of acres of land made idle by the crop reduction program, they looked to their scientists for a solution. The scientists responded by developing such grasses as Fescue, Kudzu, Dixie Reseeding Crimson Clover, Lespedeza, etc. The South shows what scientists can do when they direct their efforts toward the needs of the people.

How to Utilize Human Resources

If you are to be successful with bringing people into the province of the teaching of science, you must understand the human community. It is in communities that we live, develop our aspirations, and find the mechanisms for survival and progress.

"The community," as Vance so well defines, "may be regarded as the total organization of social life at the local level. The community, however, is not an organization for any one single purpose. It is the local area where social institutions—family, church, school, government, and business units—converge. The organization of a community is sought in the interrelations of the various units and agencies of social institutions located there. . . . When it breaks down, economic life also breaks down. It is connected to the larger economic life of the national state by distribution, transportation, commerce, and finance; and by all the services of 'intelligence' and communication." *

The impact of changes in the economy are first observable in local communities. We need to know all the units that make up the total community. We need to know how they are interrelated. We need to know the dominant personalities in each segmented unit of the community. We need to know what the needs of each unit are, and how to communicate with the leadership of each unit.

After gaining such an intimate knowledge of the community, then we are in a position to know the dominants in the various groups that go to make up the local community or neighborhood that our school serves. We can find out what their interests are and why they are able to influence people. We can find out from them what their problems are; to what extent problems in one group are caused by the behavior of other groups in the same locality; and, above all, we will know what problems people have in our localities that fall within the province of our special subject matters.

The Rural Life Council of Tuskegee Institute is very much interested in the rehabilitation of run-down rural farm communities. In one such community, the principal planned a rather effective program for the regular PTA meeting. We wanted a mild shock to get an action program under way. We let the students tell their parents what was wrong.

The discussion was arranged as a panel. One of the students presided and asked the following questions:

1. Why are you leaving Cross Roads when you finish high school?
2. What do you want in the community in which you shall live?
3. What would have to be done in Cross Roads for you to stay here?

The following are typical of replies given by the students:

* Vance, Rupert B., "Social Organization for the Use of Industrial Resources," *Bulletin of the Bureau of School Service*, College of Education, University of Kentucky, Vol. XX (June, 1948), No. 4, p. 121.

"I would not like to stay in Cross Roads because in Cross Roads we can't get enough money, and we have no place to go for recreation. There are no good roads so one can travel easily. We don't have jobs to do after school so we can get some money; and if you could get one, you couldn't get enough money to buy the things you need most."

"In order for me to stay in Cross Roads, these following things will have to be here: More money for the work we do; more jobs without working in the fields; a place for recreation; a telephone; theatre; better homes; a doctor close around in our community; and a better water supply."

"I'm leaving Cross Roads because of my economic condition. For instance, there is not enough money; no jobs for high school girls and boys except plowing and hoeing during the summer. If we would like to go to college, our income would not support us. No doctors except quacks, and they are not fit to use in any case. Recreation is very poor; there is no place to go during our leisure time. The only way I'll stay in Cross Roads is: In the home there will have to be running water, electricity, sanitary privys, house well equipped, and a car. In order for us to get these things, our farm products must be improved, we must use what we have, and try to get more."

"The reason I could not stay in Cross Roads after I finish school is, first, there is no place to get a job except working in the fields all summer. There is no place to go but to church on Sunday and back home again. Can't get to the movie but once a month, and sometimes not that regularly. There is no money to be made by working in the hot sun all day long for about $1.50 a day. The reason I am leaving Cross Roads is to get better recreation, better work for more money. What I want in the community in which I shall live is better homes, better recreation, better work for more money, and better transportation."

"I really think that the roads could be better; more homes could be well equipped with electric lights, radios, phonographs, and washing machines; more entertainment could be had at the churches and school; and more corn, cotton, chicken, cattle, milk, pork, and vegetables could be had for your own use and more for the market. If we could have more money, we could have these things."

At the conclusion of the students' reports the principal said, "You have heard what the students have on their minds. They have said why they leave. Maybe we don't blame them, but is there anything that we can do to keep some of them in the community? Now let us have your reactions to the things they have said."

The discussion continued for a long time. Before the PTA meeting ended, a local community planning group was organized. This group began a thorough study of the community needs and the needs of the young people. On the second Sunday of each month, the people of the community come and meet with the group to study their problem. Some of the things that have already been accomplished are: (1) The employment of a physical education instructor to help with the problem of recreation. (2) The Vocational Agriculture teacher encouraged some of the farmers to try new crops and carry on soil improvement practices. He also organized a cooperative market to dispose of the new crops. (3) The most amazing accomplishment was the Community Savings Club which started off with $1.50. This club has grown into a chartered Federal Credit Union with $400 in the treasury. It's goal is to finance farm operators in the community and other credit needs of the people. It will achieve these goals because the people, with the help of their school teachers, have decided in what direction they want to go.

Most of our efforts in working with communities fail because we attempt to impose plans on people without considering the relation of the plans to the people concerned. We are also guilty of

working on symptoms rather than probing for the causes. This explains why I have placed so much stress on the interrelatedness of life, as a whole, and the interdependence of groups and institutions that go to make up our human communities. It is highly possible that many of the social problems we are worrying with today have their origin in the change-over from a simple, isolated community life to our highly complex modern communities. This is a whole life problem. We cannot expect to find solutions in compartmentalized approaches. We must learn how to blend our various specialties of knowledge into a well functioning organic whole. Science teachers, then, along with other areas of subject matter, want to learn how to fit their work harmoniously into this organic whole.

The Use of Experiments in Biology Teaching*

HARVEY E. STORK
Carleton College, Northfield, Minnesota

Our observation of biology teaching in secondary schools and colleges leads us to question whether we are not in danger of becoming so absorbed in the multifarious facets at the periphery of the extensive subject matter that we may lose sight of the central basic objective. We wander far afield trying to teach something about everything. We set out to discover the pupil's needs so that we may meet those needs. So extensive are the applications of the principles of biology that we find the pupil needs just about everything and that, it sometimes seems, is what we are trying to teach. We have undertaken, for example, the teaching of first aid since the pupil needs to know how to take care of the human body in health and disease. We have introduced pre-medical subject matter as if we expected everyone to become a physician. In one textbook as much space is devoted to human blood groups and the Rh factor as to the fundamental process of photosynthesis. We are now enjoined to teach all about conservation which in itself comprehends all the natural sciences. These are illustrations of the many directions in which we stand in danger of being diverted to the neglect of our main objective. All are worth while, of course. Our question is not just what is worth while, but what is *most* worth while. One is reminded of the yokel who went to the circus and became so intrigued with the side shows that he never got into the main tent at all.

The main tent, it seems to us, is an understanding of scientific method. While we no longer think of *the* scientific method as some magic key which, once acquired, will serve to unlock all of life's problems, yet there are methods of procedure and fundamental habits of thinking that are the peculiar marks of one who understands science. This mental attitude has these characteristics: doubting all things reasonably, knowing what constitutes proof, suspending judgment until all the evidence is obtained, being aware of differences in the degree of accuracy, exercising caution and precision in drawing guarded conclusions, and above all rebelling against the tyranny of unwarranted authority.

We would probably all say that, of course, we are teaching scientific method. We take it for granted that scientific

* Presented at the annual meeting of The National Association of Biology Teachers, Cleveland, Ohio, December 28, 1950.

habits of thought will develop if only we teach enough scientific subject matter. But are we not so involved in putting across facts of life processes and structures as to take too much for granted about the main objective of science teaching? Scientific habits of thought can not be taught in a vacuum. We must work with organisms, first hand, in the field or laboratory. You will not agree with the professor of philosophy who told the writer that he could teach the scientific method to his class in thirty minutes of his lecture.

Some teach from the textbook, some depend on demonstration experiments, and all too few allow the pupils themselves to participate in the laboratory procedures. These seem to us to parallel three ways of developing an understanding of and an interest in football. One group reads about Saturday's game in the Sunday paper; a second group sits in the stadium and follows the plays vicariously; a third group actually gets hold of a ball and kicks it around, blocks and tackles, even if it's only on a sandlot with the neighborhood kids. The latter know football itself and not just something *about* football.

Of all laboratory procedures, it is our thesis here that the scientific experiment is the most effective for developing an understanding of science. Though it is the heart of the laboratory method it is always in danger of being crowded out by study of structure, by "busy work" types of putting in time drawing endless cells from pretty tissues artificially stained in unnatural Joseph's coat colors, or similar work of little effect in provoking thought. This is so because the experiment does require much time and thought in preparation on the part of the teacher and often calls for added materials and equipment. So the teacher conveniently shrugs off responsibility by saying, "We do not have the time or money." In the experience of the writer, the best answer to this is that where there's a will there's a way. We have seen the contagious enthusiasm of the teacher infect the superintendent and even members of the school board to the point where the "impossible" was accomplished.

The experiment is the key factor in the process by which man has won his present understanding of the universe. His progress is written in terms of experiments that freed him from the bondage of authority based on mere speculation. For example, the great Aristotle taught that the tissues of plants are built from the substance of the soil by a sort of transmutation. For centuries this was the belief and teaching of scholars. It must be so, they argued, because Aristotle himself had said so. More than nineteen centuries later a Flemish physician and chemist dared question this authority. He performed a simple experiment. A translation of Jan Baptista van Helmont's report follows:

> "I took an earthen vessel in which I put 200 pounds of soil dried in an oven; then I moistened it with rainwater and pressed hard into it a shoot of willow weighing 5 pounds. After exactly five years the tree that had grown up weighed 169 pounds and about three ounces. But the vessel had never received anything but rainwater or distilled water to moisten the soil when this was necessary, and it remained full of soil which was still tightly packed; and lest any dust from outside should get into the soil, it was covered with a sheet of iron coated with tin but perforated with many holes. I did not take the weight of the leaves that fell in the autumn. In the end I dried the soil once more and got the same 200 pounds that I had started with less about two ounces. Therefore the 164 pounds of wood, bark, and root arose from the water alone."

This simple experiment reminds us of the late Hendrik van Loon's statement, "A drop of science is often enough to

disinfect a whole barrel full of ignorance and superstition." We can forgive van Helmont for being only half right in his conclusion.

President Conant would have us teach science by letting the pupil repeat such significant classical experiments as this. While that would be useful in developing an understanding of the history of science, we doubt that such a warmed over fare would be as stimulating as genuine experiments to which the pupil does not know the answer beforehand. Most of our standard textbook experiments are not genuine experiments at all from the viewpoint of the pupil, but merely manipulations of material and apparatus to demonstrate how a question was once answered. The pupil no doubt acquires skill in handling materials and apparatus thereby and has his attention focused sharply on the principle the experiment is designed to illustrate. But he misses the thrill of seeing how the experiment comes out, for he has the answer before he even starts.

Some will say it is impractical to have pupils perform original experiments to which the answers are unknown, that this procedure belongs to the graduate laboratory. They fail to take into account the difference in magnitude of problems. An experiment performed by a high school pupil will probably make no great contribution to the advancement of science. But it can make a great contribution to his own understanding of the method of science. For example the standard textbook experiment purporting to prove that light is necessary for photosynthesis may be presented with cookbook directions to cover a portion of a nasturtium leaf, expose the leaf to light for a period of time, dissolve the chlorophyll, and then stain in a solution of iodine. He may cover the leaf by folding a piece of foil double and clipping it over the edge of the leaf. Or he may be directed to sandwich a part of the leaf between two pieces of cork. When the iodine stain shows no starch in the covered part of the leaf, he writes the conclusion in his workbook that light is necessary for photosynthesis. This is a good example of a bad experiment. In a valid experiment all the factors are controlled except the one in question. The only justifiable conclusion he can draw in this case is that starch does not form in the leaf of this particular species of plant when (1) light is excluded, (2) gas exchange is impaired, and (3) transpiration is excluded. Even when he succeeds in controlling the two latter factors, his conclusion can refer only to the species of plant under experiment. Care in controlling all factors except the one under investigation, caution in observing results, precision in recording them, and guarding against drawing unwarranted conclusions are among the marks of a good experiment. If these are not rigidly observed the result may be to confirm the pupil in slipshod thinking rather than to inculcate precise habits of scientific thinking. Let the pupil perform the light exclusion experiment on a plant in which no starch is produced, as for example, most members of the Lily family. When he thinks his experiment has "failed" you are in a good position to point out that experiments do not fail, that the outcome is always the same under any set of conditions. Here the pupil is ready to begin a genuine experiment or series of experiments to find out why the liliaceous leaf shows no iodine stain, what other plants are in the same category, and other questions to which he does not know the answers. Many of the standard experiments may be varied from their cut and dried routine into problems that are of vital significance to the pupil by stating the question in quantitative terms. Thus, the pupil may

ask how intense a light is necessary to show first traces of starch. How long a duration of light is necessary? Are artificial light sources effective? Is light that filters through a red cellophane screen effective? How do different color qualities of light (checked as to intensity) compare? How long does the starch remain in the leaf after illumination?

We realize that time and economic considerations present plausible alibis for failure to go into a program of original experimentation. We agree that the routine standard experiment as given in the workbook has its place as does the demonstration experiment. Furthermore the textbook and wide collateral reading as well as lecture presentations and audio-visual aids are not to be condemned. But our experience has shown that the best way for a pupil really to strike fire and begin to understand what science means is for him to answer a question by the experimental method so that he can say here is something to which he and he alone knows the answer. It is often the open-sesame to an enthusiasm for the subject. Even if the pupil can devise and perform but a single experiment among all his routine of acquiring masses of information about life processes and structures, that one experiment may prove to be a great leavening. The precise laboratory experiment achieves this better than the more diffuse types of problems that our workbooks present which can be answered by the collection and arrangement of data acquired from observation in the field or community or the collection of information from books.

Practical Application in the Teaching of Biology[1]

D. F. MILLER
The Ohio State University, Columbus, Ohio

Many years ago I knew a man who had a good set of wood-working tools which his sons liked to use. Although these were tools easily broken or dulled the boys were always allowed to use them. They were taught how to hold a plane and a saw, to watch out for nails, how to sharpen an edge if they dulled it, how to run a chalk line and use a spirit level. The father was convinced that the way to learn how to use tools properly was by using them, not by keeping them locked in a chest.

We all recall the old lines that ran: "Mother may I go out to swim?" "Yes my darling daughter. Hang your clothes on a hickory limb, but don't go near the water." Sometimes it may appear that in our teaching of sciences we are locking the chest of tools until the boy knows how to use them or forbidding the child to enter the water of experience until he learns to swim. In the study of health it would be as impractical to teach the subject of disease organisms without making cultures of bacteria, molds, and protozoa as it would be to teach oxidation in chemistry without chemicals to demonstrate the reaction. The former is frequently done—the latter, seldom. I shall try to point out some concrete examples of the types of practical applications that can be used in the teaching of biology. The examples cannot be numerous but I hope they will point to a way.

[1] Presented before THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS at its annual meetings with the A.A.A.S., Cleveland, Ohio, December 28, 1950.

Recently I walked into a classroom where college students were studying methods of teaching biology in secondary schools. The instructor in charge of the class was sitting at a laboratory table near a student with a microscope. From the fragments of a dissected frog and conversation I deduced that they were looking at the kinds of organisms that inhabit the internal organs of these amphibians. I'm sure its intestines gave up several kinds of protozoa, many bacteria, roundworms, and likely the eggs of flatworms, the adults of which could be recovered from the frog's lungs. I did not stay to hear the discussion but I did ponder the possible ramifications of such a period in a high school biology class.

No group of students ever fails to show an exciting interest in this particular study of parasites and commensals. The teacher is likely to go home feeling "Well, I did a good job today." The interest was inherent in the nature of the materials used, so it was a good job of choosing material; there was an arousing of interest in the field of biology; all of which is good. But is it to stop there? What will tomorrow's subject be? What advantage is to be made of this new interest?

Don't let a period of this kind run until the dismissal bell rings. Take at least five minutes before dismissal to jot down all the questions a class will ask. Don't answer them, but write them down quickly with the promise that these (and other questions) will be discussed at the next class period. You will get such as "Do these things hurt the frog?" "Do they live on the frog's organs?" "Will they kill the frog?" "How do they get into its body?" "Do *we* have such things crawling around inside of us?" "How can they be gotten rid of?"

What a beautiful background for study of parasites and hosts, their relations to health of domestic animals and man, their life histories and controls. Do you have students learn the life history stages of the malaria parasite, a tapeworm, or a fluke only to find that they can't remember or don't try to remember? If a student learns that one in every four or five persons probably has a little roundworm causing a disease called trichinosis and that the control is best understood by knowing the worm's life cycle, he is interested in learning that life cycle. The simple statement "Cook your pork before eating it" isn't sufficient. They must know that helping to butcher on the farm, handling raw meat in a butcher shop, or preparing it in the home for a meal can infect one with the parasite. When there is understanding, facts become practical.

Control of parasites necessitates a study of ecology, behavior, hosts, carriers and other means of transmittal. Would two or more boys like to trap a wild rat and dissect it for its parasites? Would someone else like to visit a veterinarian and find out about common parasites of pets and food animals and what he recommends for them? Would another be willing to visit the county or state public health laboratory to see how some of their problems are handled? Was the teacher ever in any such laboratory? If not, would the teacher admit the lack of this knowledge and go along as a co-adventurer? Let not an interesting class period be sufficient unto itself, good as it may be. But make practical use of it for as many subjects and as many students as possible.

One day I walked into the biology classroom of a large city high school and saw there a very well-prepared demonstration of hydroponics. It is commonly known by the name "water culture" or "gravel culture" of plants. This was quite popular a few years ago and is used commercially under some conditions. As a teaching device it has de-

cided value when properly applied. It certainly is interesting to look at just as an aquarium is interesting. Sometimes we stop there but we shouldn't. Sometimes we go further, explaining what chemicals are used in each culture medium and what effects the presence or absence of some of these have upon plant growth. The demonstration that I saw had been constructed by the students. The chemicals were weighed out and mixed by them. They planted the seedlings. But in the particular school where I saw this demonstration the story of hydroponics did not end here. A committee of the class called all local greenhouses to see if any of them used hydroponics. They visited those that did. They made a complete report to their class of how hydroponics was used in a practical way. It led next into a consideration of the origin and the constituents of soils, the preparation of soil for potted plants, preparation of flower beds around the home, the backyard garden, farm practices and fertilizers. It went on into soil and water conservation as applied to their local region and to their state. Hydroponics for its own sake is not worth very much in a biology course; but hydroponics as a basis for practical applications of the principles which it involves may be an excellent adventure in classroom procedure.

How did problem-solving enter into such a procedure? This particular school was located in a suburban area where the people took some pride in the appearance of their homes. Flower gardens were common. Knowing this, the teacher asked several students what kinds of flowers they grew. In the discussion one boy objected to another's list of flowers because, he said, the soil was too acid for some of the flowers to grow well. So the teacher assigned him the problem of finding out how to grow such plants. There followed soil testing of samples brought to the school laboratory from his home. What was meant by acidity and alkalinity of soil? What could be done to correct it? There was a visit to a commercial florist, an introduction to the study of plant varieties and their requirements, and a home project (suggested by this student himself) on preparing a flower garden suitable for such plants as those that brought up the problem in the first place. Thus a lot of practical applications of the subject matter were made, perhaps the *most practical* being that problems which were *real* to the students were solved by them.

Nothing could be of greater value to students of science than to be made conscious of the methods of science to such an extent that these methods become functional. You can't do this by merely talking about "the scientific method." The student must have repeated practice in solving what he himself recognizes as a problem. When he does become aware of the feeling that he has successfully met the challenge of a difficult problem you will find him looking for problems to solve, like the boy who is fearful of going into water until he discovers that he can swim without too much difficulty. After that he is eager to go swimming.

There is another approach to this matter of being practical in biology teaching that seems to me to be of considerable importance. Some years ago a former student teacher of mine accepted an appointment as biology teacher in a small junior college where most of the students would not go into higher education but needed something practical to take back home which was usually on a farm. This teacher came for some help in planning a course. His first question was "Is there a book that offers such a course?" We decided there was not such a book, he'd have to prepare his own course. The second question was "Then

what shall I teach?" We decided that since these students were taking a terminal course in natural science they should gain some *basic understandings* of biology that would be the outcome of their study of the subject. These understandings we wrote down as we agreed upon them. With these understandings as his objectives it became this teacher's problem to decide upon what subject matter and what methods he should use to accomplish his goal. (I am happy to report that he was quite successful in his endeavor.)

With slight modifications the following are these basic understandings as they were used:

1. The only known source of life is from living substance.
2. The common unit of living substance is the cell.
3. The basic process in the formation of living substance is photosynthesis.
4. Life processes are chemical reactions involving interchanges of materials and energy.
5. Life processes are essentially the same regardless of the organism in which they occur.
6. Diseases and disorders are the result of interference by factors which affect these life processes.
7. Vitamins, enzymes and endocrines are regulators of these processes.
8. Immunization and correction of diseases and disorders often may be obtained through the proper use of antitoxins, vaccines, drugs and foods.
9. Much of the commercial advertising of foods, antiseptics, drugs, vitamins, and other preparations is not supported by scientific data and is often deliberately false, misleading, and sometimes detrimental.
10. A sufficient familiarity with facts combined with scientific thinking is a safeguard against such imposition and is useful in solving everyday problems.
11. A reasonable understanding of natural phenomena is a source of satisfaction and a means of fuller living.
12. The most fundamental industries of man are based directly upon plant and animal life.
13. Living things have descended through time with wide variation in form of expression.
14. Variation in the expression of life through time is a function of the genetic composition of the individual and the environment in which it develops.
15. The improvement of domestic animals and cultivated plants can be brought about most rapidly and most effectively through the understanding and application of the principles and laws of genetics.
16. These same principles and laws are applicable to man.
17. Social problems are essentially biological problems and should be solved as such without resorting to emotionalism.
18. Health is a potent factor in human happiness.
19. Science is ready to modify its generalizations in the light of new evidences.

It was not intended that these formal statements should be learned by students. They are for use by the teacher. It becomes the teacher's duty to see that what is implied by these statements is a part of the pupils' understanding and appreciation.

The papers by Mrs. Brown and Mr. Finlay, the digests of which follow, were presented as a part of the NABT session on *Program Planning in Biology*, Thursday, December 29, 1950.

Fitting a Program of Biology into a Community Centered School

MRS. M. GORDON BROWN
Science Coordinator, Atlanta High Schools

September 5, 1947, marked the beginning of a new era in the Atlanta School System. To better help the girls and boys of the city to meet the needs of a demanding world the school system was converted from the Kindergarten 7–3–3 plan of education to the Kindergarten 7–5–V plan. The conversion called for changes in plans, methods, plants, transportation and organization. In the high schools, co-education replaced non-co-education; buildings which had separately housed either junior or senior high schools were now converted into community high schools equipped with proper facilities to care for new curricula; traditional viewpoints were modified to meet changing needs. Plans for changing from educating or being educated in long established, traditional, non-coeducational high schools to training in co-educational community high schools required a re-examination of the purposes of education by all concerned. A Curriculum Coordinator was appointed to co-ordinate the new program of studies. He became a member of the Executive Committee for Curriculum Revision which directed the transition. The other members were the Superintendent, a Board member and the Supervising Principal. Subject-area committees, composed of teachers, were appointed to draft programs in the various fields.

The teaching of science begins in the elementary schools where it is felt that an effort to help children use scientific procedures and knowledge should logically commence. The science program is organized around problems that result from the interests and needs of children. The whole community is the laboratory.

Atlanta is fortunate in having for its children two excellent sources of help for enriching the science program. One is Fernbank Memorial Forest, a seventy-five-acre tract of wooded land, with a stream running through it. This offers opportunity for first-hand experiences with plant and animal life. A science museum, housed in a building on the grounds, is being established. The other source is the Atlanta Board of Education radio station. A fine series of science programs on the elementary school level is produced and broadcast weekly. High school programs are also broadcast weekly.

A city-wide elementary science fair held in the spring under the leadership of the elementary supervisor has been effective in stimulating interest in science. Over ten thousand children, teachers, parents and friends took advantage of the opportunity to see the fair this year. The Georgia Science Fair has been held in Atlanta for the past few years, therefore the high school students do not have a separate Fair.

The science curriculum committee worked with the over-all coordinator in planning the science program for the

community high schools.

Since all science courses could not be required for all girls and boys, the general executive committee, cooperating with the science committee, asked the Board to inaugurate the following program which is now in operation in the high schools:

1. A required program, including:
   (a) One semester of health science in the eighth grade.
   (b) Two semesters of general physical science in the ninth grade.
   (c) Two semesters of general biological science in the tenth grade.
2. An elective program, including:
   (a) Two semesters of chemistry in either the eleventh or twelfth grade.
   (b) Two semesters of physics in either the eleventh or twelfth grade.
   (c) Two semesters of human biology in either the eleventh or twelfth grade.

Health science and general physical science are scheduled to meet daily for single periods. General biology, chemistry, physics and human biology are definitely planned laboratory courses scheduled to meet for three single and two double periods per week.

Since there is such a diversity of subject matter which could be covered in different science courses, it was necessary to be specific in outlining the content to be presented in Atlanta. To settle this important problem six separate science curriculum committees were appointed, each composed of a teacher from each high school. Thus the biology curriculum committee is composed of teachers of biology, the physics committee is composed of teachers of physics and so on.

The biology teachers faced particularly difficult conversion problems. One required, general biology course at community high school level was being substituted for both a general, non-laboratory, required junior high school course and a year's work in highly specialized, elective zoology and botany which had been taught in non-coeducational senior high schools.

Not only was it necessary to change the type of course but also the methods of presentation. The committees had to decide what needed to be done and how to do it. Several things had to be kept in mind in making these decisions. Especially important were these points:

1. What preliminary preparation would the girls and boys have?
2. What particular biological perspective should they get in community high school training?
3. How could biology training be organized so that principles which would make better citizens would not cause the sacrifice of adequate factual information which might serve as a basis for further study?
4. What adjustments would have to be made by the instructors themselves in order to teach a required general biology course?

The biology curriculum committee assisted by the Curriculum Coordinator and two superior science consultants, faced the problems with courage and wisdom. A bulletin was developed to give a point of view on objectives, methods and evaluations.

The committee suggested eight big problems or projects which would form the subject matter of study for the year. They are:

1. What are the differences between living and non-living things?
2. What are the varied forms in which life occurs?
3. What are foods and how are they made?
4. How do living things use food?
5. Why do living things act as they do?
6. How does life continue?
7. How are living things like their relatives?
8. What constitutes our biological heritage?

How can these problems be meaningfully solved by girls and boys? In order to emphasize the correlation between

classroom and community, we first study the varied forms of life in the community. Probably for the first time the girls and boys see that they are organisms in whom all the biological principles are working. They see themselves as agencies through which the principles they are studying become effective as they adapt to the changing environment. They see that they adapt to air, food, plants, animals, beauty, sanitary conditions, natural conditions and so forth. After they understand that these biological principles are working in themselves they are directed to figure out how they can make them work to improve their environment, how they can make science work for them. This is the approach used in general biology and later in human biology to try to make the study of this science part of a student's intellectual equipment. By first arousing interest in the person as a biological organism and awakening in the person a sense of responsibility to the community; second, by showing how his knowledge of biological principles can be used to better not only himself but his community. This type of teaching requires many field trips, many projects and much good planning, both by teachers and students if it is to be effective.

Covering a certain amount of textbook material must become secondary. Many projects have been used, no different from those with which all are familiar. Here are a few examples: Several dental clinics which serve all the schools in an area have been established in the high school within the area in question. A holiday is given yearly to the Atlanta schools whose pupils have completed all necessary dental work. Often, the biology classes sponsor the dental drives that are necessary to earn the holiday. They plan and present dental programs which teach why it is important to take care of the teeth. They serve as staff assistants in the clinics, cleaning instruments, running the sterilizer, checking and alphabetizing the dental cards and keeping traffic moving during the dental examinations, not only when their classmates are having their teeth examined but also when children from the elementary schools are being examined in the clinic. Some biology students have assisted dentists in carrying out experiments that may prevent tooth decay. Biology students render similar services during other health examinations. The Atlanta Tuberculosis Association has been pleased with the excellent educational programs presented to the entire student body by human biology students before the chest X-ray examinations are made. Other biology classes have taken charge of beautifying the school yards. One boy became extremely interested in plant propagation when he learned that he could root a cutting from a gardenia bush. His mother had always wanted gardenias in her yard, now he had found a way to grow them for her.

Problem-solving is being stressed in attempting to show girls and boys how superstitions originated and how evidence proves that they are untrue. The unfairness of prejudices and their far-reaching results is developed as a problem. Students are urged to use the scientific method in deciding what subjects to elect for the next year and in deciding what to do after graduation from high school.

Fitting a program of biology into a community-centered school is a difficult problem, one that requires much intelligent effort. The Atlanta biology curriculum committee, meeting weekly, after school hours, is now preparing a syllabus for teachers. It is hoped that this guide will serve to provide more effective ties between the biology class-

room and the community. Certainly this is one of the most important problems facing high school science teachers today.

Conservation Education in a Biology Program

ROBERT R. FINLAY

Conservation Instructor, John Marshall High School, Cleveland, Ohio

So that we may better understand each other and at least start this discussion on common ground it seems logical to present certain interpretations concerning the subject. To begin with, any complete course in conservation ought to include consideration of human as well as natural resources. If one attempts to do this with any degree of thoroughness, he is not long in discovering that it is an extremely difficult task. There are numerous aspects in each of the categories. What to put in and what to omit are continuous problems that are difficult of solution in the preparation of any syllabus on conservation.

Most high school students as well as the man in the street will tell you that conservation means the saving of coal, or trees, or soil, but I have yet to hear one list man's energy, or his family life, or health.

I suppose we might change the thinking of these people in the next few years if we always used the phrases "conservation of natural resources" or "conservation of human resources" rather than the one word as is now our custom.

The teaching of conservation is now one of the major considerations throughout the country. At the present time there are many organizations actively campaigning for its inclusion in the school program. Each flood, dust storm, forest fire or municipal water shortage now gives added impetus to this movement which was inaugurated about the turn of the century but has achieved real recognition only in the past twenty years.

I am in no position to say that all conservation groups are in accord as to what should or should not be included in teaching the subject. Undoubtedly many of the organizations have special interests which they believe important and in local situations they might well be. It is my belief that a local committee should work out the aims, objectives and subject-matter fields as well as the economic, social and scientific fundamentals which should be incorporated in the program. Such a committee would include representatives from various conservation groups, governmental agencies concerned, school administrators and experienced teachers.

After this committee had agreed upon the general concepts, I would suggest that another group of specialists work out the details. This commission would concern itself with the application of tried educational practices to the grade levels and subject-matter areas. A set of syllabi might be formulated which would outline diversified procedures for use by the various instructors. The ultimate selection of material and methods of presentation should rest with the individual teacher.

From the foregoing comments you have probably surmised that I am in favor of introducing this new course as a part of several subjects already in the program. My reasons for this choice should be quite obvious. First of all, my interest in conservation is such that I want to see it included in the prescribed course of study. I fully realize that to demand its inclusion as a new subject

would be a grave mistake and might well postpone favorable action for a long time. On the other hand, as a classroom teacher, I am somewhat familiar with the present tendency toward the integration of subjects within the school program. Since conservation readily lends itself to this situation, I feel that many authorities might be more susceptible to a favorable consideration of the plan. There are further comments I might make along these lines but time does not allow.

Let us suppose that your local Board of Education has decided to include conservation education in the curriculum and that the administrators have solved the major problems attendant upon its introduction as an integrated subject. It is probably safe to say that in this situation the biology teacher will be asked to assume a leading role. I can think of no other science course which could as readily present a substantial amount of factual knowledge and at the same time provide for conservation activities.

Some of you have already decided that you will have no part of such a program. Some of you would accept it under mild protest but most of you would take it in stride and I am sure would do a very creditable job of it. Perhaps a goodly number of you have been participating in such a plan and could offer the rest of us some very practical advice on the subject. I am inclined to believe, however, that many of the difficulties associated with the revision of a course outline are more imaginary than real.

Some instructors tell me they prefer to present the subject as an independent unit just as they do with "heredity" or "land plants." Another group will choose to follow their present outline and to emphasize the various aspects of conservation as they relate to the unit under discussion. Either of these methods should prove satisfactory but a combination of the two would undoubtedly receive the approbation of the majority of instructors.

All three plans indicate that some selected textbook serves as the basic outline of the biology course. Is it fair to assume that this is a general practice among biology teachers? If the answer is in the affirmative, and I have been told that it should be, then we ought to give some consideration to the conservation contents of biology texts.

A year or so ago I asked a former science teacher to comment on my suggestion that biology would be a very acceptable course through which to introduce the subject of conservation. His reply is well remembered for he implied that all textbooks would have to be revised and rewritten and that the inclusion of the additional material would greatly increase their size. This, he thought, might prove somewhat discouraging to both pupil and instructor.

Shortly thereafter I had the opportunity to look through three different biology textbooks. It is true that they have increased in volume as far as numbered pages are concerned. I recall that one of them ran over the thousand mark but I am certain that it was printed in somewhat larger type. My greatest surprise, however, resulted from the discovery that the publishers and/or the authors had anticipated the need for conservation material, for two of the books contained very carefully prepared units in this field. The approach was decidedly different but I found much of interest in each copy. If I were called upon to select just one of the three, I would immediately choose the one that concluded each unit with a list of projects. This is a natural choice, I suppose, since my present conservation course gives much attention to projects. And since we have mentioned this topic, I should like to make some further comments at this time.

One of the requirements in the Con-

servation course at John Marshall High School is the completion of a project each semester. Should a student elect a particularly difficult undertaking he is allowed two terms in which to finish the job. Again, in certain instances two boys are granted permission to double up on a problem. Occasionally a student will complete two in one term. We have prepared a list of sixty-one projects which we furnish in mimeographed form to each pupil as he reports for his first class in the new term. He is allowed two weeks in which to make his selection and he is permitted to change his mind at a later date if he discovers the material is unavailable or the cost is prohibitive. Let me give you a little information about a project in each of the situations which I have just mentioned.

As an individual achievement for one semester a student might prepare an insect collection and set it up for display in our classroom. Two boys may team up to construct an electrical questionnaire board. In this device, operated by dry cell batteries or with a doorbell transformer, we have a number of pictures secured on a piece of plywood (or similar material) and the printed identifications located along one edge. The layout is so wired that the student being questioned will cause a bell, buzzer, or light to operate when a correct identification has been made. Needless to say, it requires some financial outlay and many hours of time to complete this sort of thing. At the present time my boys are in the process of completing four more of them. They are titled: local spring wildflowers, Ohio mammals, common weeds of this locality, and devices used in erosion control.

As an example of a project which a student might carry on for two semesters I should like to suggest a small ecological survey. In our plan of procedure the boy selects a site (usually local fields or the edge of our Metropolitan Park) and prepares a map of the area. He indicates topography, outstanding geological formations and dominant plant life on this map and then keeps a chart giving detailed information concerning birds observed (nesting, in flight, or feeding), insects (types and quantity but not necessarily identified), wild flowers, animal life and other natural phenomena. Photographs of the location taken each week during the spring and fall are optional.

In checking my list of projects I find that most of them deal with some phase of biology. Therefore it seems to me that any of you who would take the time to promote this sort of thing might find your program producing lasting results. You would be teaching conservation and biology in such a manner that it would be difficult to determine the point of demarcation if, indeed, there is one. These combination biology-conservation activities are of real significance if you believe that learning is not entirely confined to textbooks.

While we are on the topic of activities I want to mention one other type which should be an integral part of every course in the natural science field. I refer to field trips.

Here is another situation in which the biology instructor may institute a program of conservation education with only a very minor effort. Of course I am assuming that he is the type of instructor who gets out of the classroom once in a while and allows the students to gain some knowledge from their own experiences.

Without going into detail let me point out that conservation may be included as a sidelight on a biology field trip or it may be well correlated within the overall plan of the day. Some brief, on-the-spot discussions of observed soil erosion, water pollution, poor forest management or scarcity of wildlife might

well be in order as you follow your original outline for the trip. On the other hand you may have decided in advance to include some of those items in your plan and will proceed to demonstrate the connection between certain biological principles and related aspects of conservation. It is apparent, is it not, that field trips provide excellent opportunities to develop conservation education in a biology program?

If and when conservation education is included in your school program it will no doubt follow the present trend toward correlation and integration of the subject matter. The drive of the sponsoring groups will be aimed at getting conservation taught in every possible subject at every grade level. As an initial compromise they might agree to a concentration of effort in the primary grades for the first year or so. Later there would be a continuous development through the elementary and secondary schools. This plan has already been invoked in several states and some cities.

Under this procedure certain courses lend themselves to the plan far more readily than do others. Biology, in my opinion, will be expected to carry an unusual load since it presents a rich, scientific background that quite readily aids a student in recognizing many basic conservation principles. I believe that an activities program is essential in conservation education and again biology presents a well diversified field in this respect.

Someone has said that the nation that best conserves its natural resources will be the ultimate survivor in this seemingly chaotic era. I know that I am not alone in hoping that this country of ours will continue to exist for some time to come. As a conservationist I hope to play my small part in this game of exceedingly high stakes. I know that you teachers of biology will do likewise.

BIOLOGY LABORATORIES

By "The Old Fossil"
At Lane Technical, Chicago

INQUIRIES. Occasionally "The Old Fossil" receives a letter in a roundabout way or with an incorrect address. His correct address is always given at the end of every *Biology Laboratories*. In case of doubt, Lane Technical High School, Chicago 18, will do the trick. All letters and post cards are answered.

THE OLD FOSSIL wishes to thank President Lockwood for the invitation to be present at the banquet of the NABT December 28, last. Although he received the invitation in early fall, he was committed to the duress of an examination at that time. "The Old Fossil," dean of the Past Presidents of the NABT, is glad to welcome Miss Lockwood into this group. Congratulations.

A FILE FOR B-L. Mrs. Muriel Beuschlein of Parker Elementary School, Chicago, writes us the following suggestion. She removes the B-L items from *The American Biology Teacher* and pastes them on 4×6 cards. She can make better use of the material in this manner.

ELEMENTARY SCIENCE CLUB BULLETIN. Mrs. Beuschlein also mailed us some back copies and current issue of the "Parker Science Clubs." These were devoted to student articles on subjects of their own choice in the fields of science and conservation. The diversity of clubs in this elementary school is exemplified in "The Mariners," "Blue Jays," "Gardeners," "Cottontails" and others. Over nine hundred guests, including pupils, teachers, parents, and visitors from other schools came to the science exhibit which climaxed last year's club activities.

POINSETTIAS. During the first weeks in September we purchased 150 poinsettia plants in two-inch pots. To insure delivery our order was placed with the florist in June. We immediately shifted them to five-inch pots with three plants to a pot. The potting mixture was eight parts loam, one part peatmoss or leaf mold, and one part fine gravel. Keep away from drafts, place in full sun, and water frequently. A teaspoon of ferti-

lizer every three weeks helps. Mix it into the top soil of each pot. Temperature in the high sixties is satisfactory. Loss, less than five per cent; costs, twelve cents per plant, ten cents for the five-inch pot. The front office, and all of Lane Tech, was just "dripping" with poinsettias for a very merry Christmas all thru December.

EXCHANGE INQUIRY. Mr. Lieberman of Los Angeles would like to exchange specimens. He collects living reptiles, mammals, and amphibians, local flora (including the ocean aquatics), together with archeological and paleontological specimens. Write to "The Old Fossil" for information and the address.

A FRICTION GAS LIGHTER hangs suspended from the ceiling over the Bunsen burner. It is attached to a coil of alloy wire taken from a spool in the physics laboratory. There is sufficient expansion to the helix to stretch to the burner for use and to lift it above the head until used again.

DURING THE WAR we prepared a twenty-page *Lane Tech Handbook of Victory Gardens*. These were for use by our students. "The Old Fossil" has a few dozen copies left. He will be glad to mail you a copy if you request it. It includes: Pamphlets and Texts on Gardening; Location of Garden; Typical Design for Small and Family Gardens; Cold Frame; Soil Preparation; Planting Guide; Specific Information on Various Vegetables; Herbs; Harvesting, Canning, Storage; Window Boxes and Lawns; and related topics.

BELATED RECOGNITION. The plaster-of-Paris card support mentioned in November, 1950, pages 167–168, was submitted by Sister M. Florentine, Charleston Catholic High School, Charleston, West Virginia.

MICROTOMES. Are you interested in microtechnique? If you are, a technician here in Chicago has for sale two good-as-new microtomes. He will sell either or both reasonably. By interpolation any thickness may be secured with the Hand Microtome. This is a Spencer. The other is a hand-operated Clinical Microtome with a high degree of accuracy. It is a B. & L. If you are interested he might be persuaded to throw in a few blocks of tissue with the deal. It may be handled as a cash sale or thru your school purchasing agent.

DR. SANDGROUND of Indianapolis has several microscopic slides he wishes to sell. They are smears of four species of Trypanosomes. He will sell a single slide, one of each, or the entire lot at a reasonable figure. If you are interested "The Old Fossil" will get you the details. The slides are of *T. rhodesiense*, sleeping sickness, human blood; African sleeping sickness, *T. gambiense; T. brucei*, from cattle and horses; *T. lewisi*, from rats.

A BIOLOGY STUDY. Margarete J. McKibben, University of Pittsburgh, sent out a *Check List of Principles of Biology for General Educational Use in High Schools*. It is excellent, comprehensive, constructive, and worthwhile. However, "The Old Fossil" would take issue with certain items designated on the list as being principles. He feels there is a difference between simple statements of facts; biological, and primary concepts; generalities; and principles. Per-

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haps this is slicing our manna too thin; but a cursory examination by him reveals that some of the principles belong in these other categories. However, this does not interfere in any way with her study. The responses to be made are the same. "It is excellent, etc." as stated.

Now if you will permit "The Old Fossil" to get down off his soap box he will give you the opportunity to step up on it by writing to him your ideas to 5061 North Saint Louis Avenue, Chicago, 25. One evening in October 1950 he was honored on his advent into the "now-I-am-fifty-club" by being selected to take over a graduate class in "Evaluation" at Northwestern University for the session. One wag from the group said, "'The Old Fossil' looks too old to stop the girls with a whistle any more, but I bet he can still trip 'em with his cane." Bye now.

BOOK REVIEWS

Menaboni, Athos and Sara. *Menaboni's Birds.* Rinehart & Co., Inc., New York. xi + 132 pp. illus. 1950. $10.00.

Don't tell me there is no Santa Claus. When advance literature on this magnificent volume of superb reproductions of exquisite paintings, with the accompanying delightful running account of the Menabonis, their bird family, and all the "doings," arrived I longed to possess the same and fixed some of the brilliance of the cardinal on the wing and the delicacy of coloring of the pair of little blue herons to my drab office wall where I could see them as I worked at my desk. They are still there but what is such a greater delight is the volume itself with its thirty-two natural-color plates, thirteen full-page black and whites and ever so many more small illustrations of such great accuracy and lifelikeness as to be a constant joy and inspiration.

The use of the personal pronoun "who," etc., is pardonable on the part of those to whom the birds are sharers of the home and delightful little companions and guests over the years. There may even be good precedent for the use of "piliated" in place of "pileated" though I cannot find one. A few typographical errors have crept into an almost flawless volume—such as "achitect," VIII; "scheech," p. 24; "omniverous," rear of Eastern Crow plate; "opague," p. 106; "carrillon," p. 108; "oppossums," p. 114. And shouldn't it be *were lichens*, p. 86, also *mile distant*, p. 89? But who would stoop to be that picayunish in the face of so much beauty of style and accuracy of observation and faithful reproduction? Every nature lover will send out a freighted hope for this beautiful book. May each one of you be granted the wish!

Charles E. Packard,
Randolph-Macon College,
Ashland, Virginia

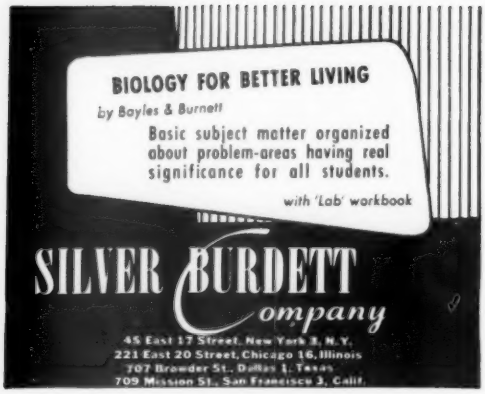
Moment, Gairdner B. *General Biology* 2nd ed. Appleton-Century-Crofts, New York. xviii + 680 pp. illus. 1950. $5.00.

This is a general textbook for colleges in its second edition. The first edition appeared in 1942. It is one of the Century Biological Series, edited by Dwight E. Minnich.

Considerable success has been attained in combining the conventional with the more modern features. Sufficiently abundant evidence has been included in support of principles and central concepts. There is up-to-date material on the Rh blood groups, the origin of life, photosynthesis, muscle mechanisms, enzymes, vitamins, respiration, plant hormones, viruses and animal behavior among other things. The methods of population genetics are applied to evolution and eugenics. The modern concept of levels of organization, that is, atoms, molecules, cells, multicellular organisms and populations is introduced. Stress is placed on the human import of biological facts and principles throughout the entire text.

It is likely that a thoughtful and conscientious student, with the aid of this book and under the guidance of an inspiring teacher, would arrive at a good understanding of the fundamental principles and the modern philosophy of biology as generally accepted at the present time.

Philip E. Foss,
Hartford Public High School,
Hartford, Connecticut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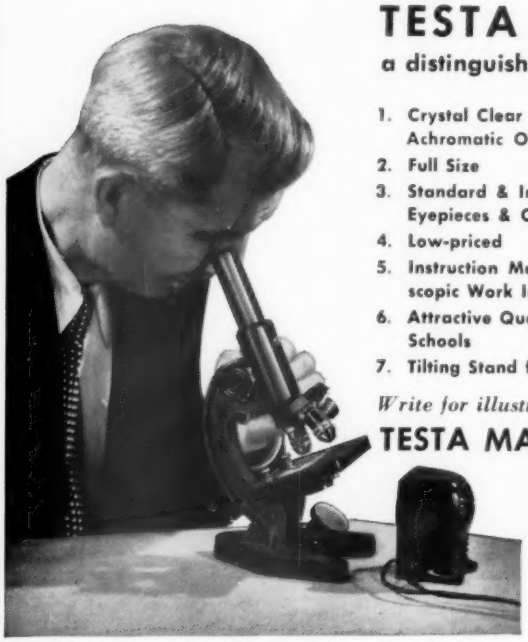

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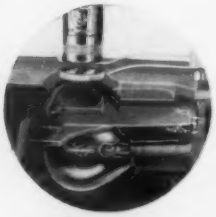

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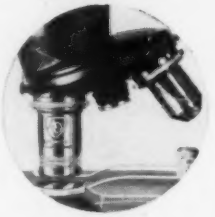

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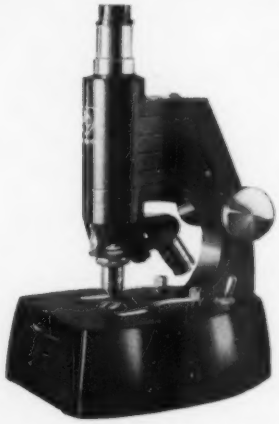

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